

**REMARKS**

Claims 1-13 are now present in this application.

The title, specification, and claims 1-11 have been amended, and claims 12 and 13 have been presented. Reconsideration of the application, as amended, is respectfully requested.

**Objection to the Specification**

The specification stands objected to for certain informalities. In view of the foregoing amendments, it is respectfully submitted that these informalities have been addressed. Reconsideration and withdrawal of any objection to the specification are respectfully requested.

**Rejection under 35 USC 112**

Claims 1-11 stand rejected under 35 USC 112, second paragraph. This rejection is respectfully traversed.

In view of the foregoing amendments, it is respectfully submitted that all claims particularly point out and distinctly claim the subject matter of the instant invention. Accordingly, reconsideration and withdrawal of the 35 USC 112, second paragraph rejection are respectfully requested.

**Rejection under 35 USC 102(b)**

Claims 1-11 stand rejected under 35 USC 102(b) as being anticipated by Sikka et al., U.S. Patent 6,174,388. This rejection is respectfully traversed.

Independent claim 1 of the present application discloses a method comprising the steps of disposing metallic filler between two golf club head members and using a heating source of infrared rays to melt the metallic filler. In particular, independent claim 1 expressly recites the step of using a heating source of infrared rays. In contrast, Sikka et al. neither teaches nor suggests employing infrared rays for joining golf club head members by melting metallic fillers. One of ordinary skill in the art could not possibly, in the absence of hindsight, have conceived of using the IR heater in Sikka et al. to achieve the method of the present invention.

Accordingly, it is respectfully submitted that the prior art utilized by the Examiner neither teaches nor suggests the method of independent claim 1 and its dependent claims. Accordingly, reconsideration and withdrawal of the 35 USC 102(b) rejection are respectfully requested.

### Conclusion

Favorable reconsideration and an early Notice of Allowance are earnestly solicited.

Because the additional prior art cited by the Examiner has been included merely to show the state of the prior art and has not been utilized to reject the claims, no further comments concerning these documents are considered necessary at this time.

In the event that any outstanding matters remain in this application, the Examiner is invited to contact the undersigned at (703) 205-8000 in the Washington, D.C. area.

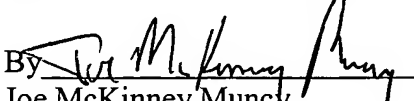
Application No. 10/695,751  
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Docket No.: 3624-0133P

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

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Respectfully submitted,

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**USING ~~INFRARED RAYS~~ METHOD FOR QUICK JOINING A GOLF CLUB  
HEAD MEMBERS USING INFRARED RAYS**

**BACKGROUND OF THE INVENTION**

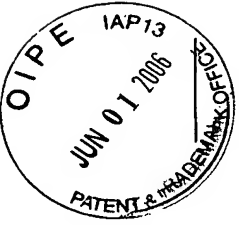
**1. Field of the Invention**

The present invention ~~is related to using~~ utilizes infrared rays for quick joining a golf club head. ~~More particularly, the present invention is related~~ head and, in particular, to using infrared rays ~~for heating the~~ to heat a filler metal which is ~~filled~~ inserted between a main head body and a striking plate to manufacture the golf club head.

**2. Description of the Related Art**

The ~~An~~ An infrared ray has a frequency in the electromagnetic spectrum in ~~the~~ a range just below that of red light. ~~Alight, and a quartz tube can radiate infrared rays in proportion to their temperature. The~~ An infrared ray ~~is~~ can be used to join separate objects within a small bonding area. ~~Infrared joining can carry out, and provides rapid heating and cooling of said on the object objects.~~

A conventional golf club head ~~is consisted~~ consists of a golf club head ~~and combined with a striking plate combined therewith. The joining method of the plate. The~~ golf club head can be selected ~~from a group of mechanically inserted method, glued method, welding method and brazing method etc. The welding method is unsuitable for assembled utilizing a variety of methods, including mechanical insertion, glue, welding, and brazing, for example. Welding is, however, an unsuitable method for assembling the~~ golf club head if the golf club head and the striking plate are made of dissimilar categories of alloy ~~that results in a poor~~ metal alloys, as this will result in a weak welding joint. Accordingly, ~~if the golf club head and striking plate are made of dissimilar metal alloys, only mechanical insertion, glue, and brazing methods can be utilized. With regard to brazing, this method requires the mechanically inserted method, the glued method and brazing method are available for the golf club head. As to the brazing method, there is a need for metallic filler to be disposed between the golf club head and the striking plate. Then the~~ The golf club head and the striking plate are ~~then~~ heated in a furnace so that the heating metallic filler is melted ~~to closely fill in a gap formed, thereby closely filling in the gap between the golf club head and the striking plate. After cooling, the striking plate is then bonded to the golf club head.~~



~~The material of the main head body of thea conventional~~ golf club head ~~includescan be comprised of a variety of materials, including~~ stainless steel, maraging steel, titanium alloy, aluminum alloy, ~~and or~~ magnesium alloy, ~~for example etc.~~ And ~~the material of the~~ The conventional striking plate ~~includescan also be composed of a variety of materials, including~~ titanium alloy, maraging steel, shape memory steel, ~~and~~ bulk amorphous alloy ~~etc.alloy, for example.~~ Generally, ~~thea conventional~~ golf club head is made of stainless steel, such as 17-4PH, and the striking plate is made of titanium alloy, such as Ti-6Al-4V. ~~In joining process, if the~~ During the process of joining the golf club head and striking plate, ~~if a conventional brazed~~ brazing method is employed, ~~heatingthe~~ speed ~~of at which~~ the golf club head is ~~heated is~~ low (about ~~5-50 degrees centigrade~~ 5-50°C per minute). In order to avoid detrimental effects caused by exposing members of the golf club head ~~to the high-temperature conditions over a long time,~~ the brazing temperature ranges ~~from approximately between 0 and 50 degrees centigrade over the melting points of~~ 0-50°C, and the metallic filler ~~is melted for for 10 to 30~~ approximately 10-30 minutes. Accordingly, the liquid state of the metallic filler ~~can wet~~ wets the members (base metal~~metals~~) of the golf club~~head for brazing them together.~~ head, so that they may be ~~joined together by this brazing method.~~ Both high temperature and/or ~~long time~~ extended exposure of the joint ~~induring conventional brazing may~~ can generally result in dissolution of the joined substrates. ~~That is,~~ In other words, in high-temperature conditions, a part of the golf club head ~~and/or~~ striking plate may be blended into the metallic filler. This is ~~so called~~ effect is referred to as an alloying effect. Once the composition of the metallic filler is changed, ~~it may affect~~ fluidity and wettability of the metallic filler ~~may be affected~~ such that construction of the joint ~~may be~~ is weakened. In addition, ~~ana~~ a brittle intermetallic compound ~~with brittleness~~ is formed between the metallic filler and the base metal of the golf club head, or between the metallic filler and the base metal of the striking plate. If a ~~thickness of the intermetallic compound is grown specifically~~ becomes thick, mechanical strength and ~~impact-resistance of the~~ impact resistant of the joined portion is weakened. ~~For this reason, the combination~~ joint are weakened. Accordingly, when combining a golf club head and striking plate of dissimilar categories of alloys ~~still mainly adopts mechanically inserted method and glued method~~ alloys, mechanical insertion and gluing methods are preferred.

Hence, there is a ~~concern for overcoming~~ need to overcome the problems associated with the conventional brazing, and improving the joined brazing method, in order to improve the performance of a golf club head formed from dissimilar categories of ~~metals~~ metal alloys. To this end, ~~generation of both the~~ alloying affect and ~~formation of an~~ intermetallic compound should be avoided as ~~much as far as possible~~ possible, in order to increase reliability of ~~at the~~ joined portion of the golf club head. Obviously, a shortened processing time and a rapid heating process can overcome the foregoing drawbacks of the conventional brazing method.

The present invention ~~intends to use~~ utilizes infrared rays for quick joining a golf club head in such a way to mitigate and/or overcome the ~~above problem, above-listed~~ problems.

#### SUMMARY OF THE INVENTION

The ~~primary objective of this present~~ invention is ~~using~~ utilizes infrared rays for quick joining a golf club head ~~which employs~~ head, and employs a geometrical optics device to focus and reflect infrared rays ~~for increasing to~~ increase the energy density and heating rate. ~~According to design choice, the~~ The geometrical optics device is ~~selected from~~ preferably has an ellipsoid and parabolic reflector whose rear surface is plated with gold and cooled by ~~cooling with~~ water. Thereby, the geometrical optics device has a preferred reflecting effect and is suitable for operation in high-temperature conditions. In order to increase power efficiency and ~~to save~~ conserve power, infrared rays is ~~penetrated~~ are transmitted through a quartz tube and focused on the ~~joined~~ joining area of the golf club head members. Since infrared rays ~~have a character~~ are capable of rapid heating and cooling, the ~~process time of joining is~~ significantly shortened. In comparison with ~~convention heating rate (approximately 5-50 degrees centigrade/min), the~~ heating time required to join the golf club head members is shortened significantly. In comparison with a conventional heating rate of approximately 5-50°C/min, the heating rate of infrared rays ~~for quick joining a golf club head is as high as 3000 degrees centigrade/min and it can~~ is as high as 3000°C/min, and can therefore avoid exposing members of the golf club head to the high-temperature conditions over a long time. Thereby, the members of an extended period of time. Accordingly, the golf club head can avoid influences of the problems associated with extended exposure to high-temperature

environments. In addition, the processing time of the present invention is precisely controlled within by a processing temperature controller, so that the process temperature is ~~unnecessary~~ does not need to be limit ranging limited to the range between 0 and 50°C degrees centigrade over the melting point of the metallic filler. Regarding ~~manufacture efficiency and automatic control~~, Accordingly, using infrared rays for joining is better than a golf club head provides both automatic control and an increased manufacturing efficiency not found in the conventional ~~blazing~~ brazing method.

The method of the present invention ~~Using~~ utilizes infrared rays for quick joining, and ~~in accordance with the present invention~~ applies to a golf club head which consisted consists of a main head body and a striking plate. The main head body and the striking plate are made of different ~~material~~ materials. Metallic filler is disposed between the main head body and the striking plate. Infrared rays ~~is~~ are then used to melt the metallic filler, and to fill the gap between the main head body and the striking plate, ~~and thus the~~. The melted metallic filler is therefore rapidly wetted and joined joins the main head body and the striking plate in a shortened period of time. The ~~material of the main head body is made of a material selected from a the group consisted consisting of~~ stainless steel, maraging steel, titanium alloy, aluminum alloy ~~or and~~ magnesium alloy ~~etc, for example~~. ~~And the material of the~~ The striking plate is made of a material selected from a the group consisted consisting of titanium alloy, maraging steel, shape memory steel, and bulk amorphous alloy ~~etc, for example~~.

~~Other objectives, advantages and novel features of the invention will become more apparent from the following detailed description and the accompanying drawings. Further scope of the applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.~~

#### BRIEF DESCRIPTION OF THE DRAWINGS

~~The present invention will now be described in detail with reference to become more fully understood from the detailed description given hereinbelow and the~~

accompanying drawings, which are given by way of illustration only, and thus are not limitative of the present invention, and wherein herein:

FIG. 1 is an exploded view of ~~using infrared rays~~ a method for quick joining a golf club head utilizing infrared rays in accordance with a first embodiment of the present invention;

FIG. 2 is an exploded view of ~~using infrared rays~~ a method for quick joining a golf club head utilizing infrared rays in accordance with a second embodiment of the present invention;

FIG. 3 is a symbol diagram of processing parameters of ~~using infrared rays~~ a method for quick joining a golf club head utilizing infrared rays in accordance with the present invention;

FIG. 4a is an SEM (Scanned Electron Microscope) photograph demonstrating the use of ~~fusing infrared rays for joining to join~~ materials ~~consisted~~ consisting of Ti-6Al-4V, Ag and 17-4PH at ~~1,000 degrees centigrade for 30 sec~~ 1,000°C for 30 seconds in accordance with the present invention;

FIG. 4b is an SEM photograph demonstrating the use of ~~fusing infrared rays for joining to join~~ materials ~~consisted~~ consisting of Ti-6Al-4V, Ag and 17-4PH at ~~1,000 degrees centigrade for 120 sec~~ 1,000°C for 120 seconds in accordance with the present invention;

FIG. 4c is an SEM photograph demonstrating the use of ~~fusing infrared rays for joining to join~~ materials ~~consisted~~ consisting of Ti-6Al-4V, Ag and 17-4PH at ~~1,000 degrees centigrade for 210 sec~~ 1,000°C for 210 seconds in accordance with the present invention;

FIG. 4d is an SEM photograph demonstrating the use of ~~fusing infrared rays for joining to join~~ materials ~~consisted~~ consisting of Ti-6Al-4V, Ag and 17-4PH at ~~1,000 degrees centigrade for 300 sec~~ 1,000°C for 300 seconds in accordance with the present invention;

FIG. 5 is an experimental data diagram of a ~~shearing~~ test for a joint ~~consisted~~ consisting of Ti-6Al-4V, Ag and 17-4PH in accordance with the present invention;

FIG. 6a is a series of SEM photographs demonstrating the use of ~~fusing infrared rays for joined to join~~ materials ~~consisted~~ consisting of Ti-6Al-4V, 72Ag-28Cu and 17-4PH at



~~800 degrees centigrade for 120 see~~800°C for 120 seconds in accordance with the present invention;

FIG. 6b is an EPMA (Electron Probe Microanalysis) data diagram of analyzing the chemical composition of a joint consisted of Ti-6Al-4V, 72Ag-28Cu and 17-4PH at ~~800 degrees centigrade for 120 see~~800°C for 120 seconds in accordance with the present invention;

FIG. 7a is an SEM photograph demonstrating the use of~~using~~ infrared rays for ~~joiningto join~~ materials ~~consisted~~consisting of Ti-6Al-4V, 72Ag-28Cu and 17-4PH at ~~850 degrees centigrade for 30 see~~850°C for 30 seconds in accordance with the present invention;

FIG. 7b is an SEM photograph demonstrating the use of~~using~~ infrared rays for ~~joiningto join~~ materials ~~consisted~~consisting of Ti-6Al-4V, 72Ag-28Cu and 17-4PH at ~~850 degrees centigrade for 120 see~~850°C for 120 seconds in accordance with the present invention;

FIG. 7c is an SEM photograph demonstrating the use of~~using~~ infrared rays for ~~joiningto join~~ materials ~~consisted~~consisting of Ti-6Al-4V, 72Ag-28Cu and 17-4PH at ~~850 degrees centigrade for 300 see~~850°C for 300 seconds in accordance with the present invention;

FIG. 8 is an experimental data diagram of a shearing test for a joint ~~consisted~~consisting of Ti-6Al-4V, 72Ag-28Cu and 17-4PH in accordance with the present invention;

FIG. 9a is an SEM photograph demonstrating the use of~~using~~ infrared rays for ~~joiningto join~~ materials ~~consisted~~consisting of Ti-6Al-4V, 95Ag-5Al and 17-4PH at ~~830 degrees centigrade for 300 see~~830°C for 300 seconds in accordance with the present invention;

FIG. 9b is an SEM photograph demonstrating the use of~~using~~ infrared rays for ~~joiningto join~~ materials ~~consisted~~consisting of Ti-6Al-4V, 95Ag-5Al and 17-4PH at ~~850 degrees centigrade for 120 see~~850°C for 120 seconds in accordance with the present invention;

FIG. 9c is an SEM photograph demonstrating the use of~~using~~ infrared rays for ~~joiningto join~~ materials ~~consisted~~consisting of Ti-6Al-4V, 95Ag-5Al and 17-4PH at 850

~~degrees centigrade for 300 see~~ 850°C for 300 seconds in accordance with the present invention;

FIG. 9d is an SEM photograph demonstrating the use of ~~using~~ infrared rays for ~~joining to join~~ materials ~~consisted~~ consisting of Ti-6Al-4V, 95Ag-5Al and 17-4PH at ~~900 degrees centigrade for 120 see~~ 900°C for 120 seconds in accordance with the present invention; and

FIG. 10 is an experimental data diagram of a shearing test for a joint ~~consisted~~ consisting of Ti-6Al-4V, 95Ag-5Al and 17-4PH in accordance with the present invention.

### DETAILED DESCRIPTION OF THE INVENTION

~~Using~~ In utilizing infrared rays for quick joining a golf club head, the present invention adopts an infrared furnace of ULVAC SINKO-RIKO RHL-P610C. The infrared furnace has 6 quartz tubes (containing tungsten heating wire) and 6 parabolic reflectors, and can be operated ~~up to 1,300 degrees centigrade at temperatures of up to 1,300°C~~. The infrared furnace is operated under argon gas or a high vacuum less than  $5 \times 10^{-5}$  mbar, ~~and~~. Preferably, the wavelength of the infrared rays ~~is ranging~~ preferably range between 0.76 and 1,000 $\mu$ m.

FIG. 1 ~~illustrates~~ is an exploded view of the method of using infrared rays for quick joining a golf club head in accordance with a first embodiment of the present invention. The golf club head ~~is consisted~~ consists of a plurality of parts, which ~~includes~~ including a main head body 1, a striking plate 2 and a metallic filler member 3. Subsequent Prior to the main head body 1 ~~combining~~ being combined with the striking plate 2, the metallic filler member 3 is disposed ~~between the main head body 1 and the striking plate 2~~ therebetween. Subsequently, infrared rays are used to heat and melt the metallic filler member 3. After cooling, the metallic filler member 3 can connect the main head body 1 with the striking plate 2. In this embodiment, the main head body 1 is made of stainless steel and the striking plate is made of titanium alloy. The material of the main head body 1 is selected from a 17-4PH stainless steel, which ~~performs~~ provides high strength, ~~corrosive resistance~~ corrosion-resistance and good wettability. The material of the striking plate 2 is selected from a Ti-6Al-4V alloy, which ~~performs~~ provides high strength, ~~corrosive resistance~~ corrosion-resistance and good wettability. The material of the metallic

filler member 3 is selected from ~~a~~the group ~~consisted~~consisting of Ag-base fillers ~~of~~such as Ag, 72Ag-28Cu and 95Ag-5Al, Ni-base fillers, Cu-base fillers, ~~or~~and Ti-base fillers.

FIG. 2 ~~illustrates~~is an exploded view of using infrared rays a method for quick joining a golf club head using infrared rays, in accordance with a second embodiment of the present invention. The golf club head includes a main head body 10, a weight member 20 and a metallic filler member 30. The material of the main head body 10 is selected from ~~a~~the group ~~consisted~~consisting of titanium alloy, Fe-base alloy, magnesium alloy, aluminum alloy, Fe-Mn-Al alloy, shape memory steel, tungsten alloy, copper alloy, nickel alloy, bulk amorphous alloy, nano-alloy, composite material and ceramic material ~~etc.~~material, for example. The specific gravity of the weight member 20 is greater than that of the main head body 10, and the material of the weight member 20 is selected from ~~a~~the group ~~consisted~~consisting of tungsten, tungsten alloy, copper alloy and lead alloy ~~etc.~~alloy, for example. The material of the metallic filler member 30 is selected from ~~a~~the group ~~consisted~~consisting of Ag-base fillers, Ni-base fillers, Cu-base fillers, ~~or~~and Ti-base fillers. ~~Subsequent to~~Before the main head body 10 ~~combining~~is combined with the weight member 20, the metallic filler member 30 is disposed ~~between the main head body 10 and the weight member 20~~therebetween. Subsequently, infrared rays are used to heat and melt the metallic filler member 30. After cooling, the metallic filler member 30 can connect the main head body 10 ~~with~~to the weight member 20. In order to avoid an alloying effect ~~upon~~on the main head body 10 and the weight member 20, the heating rate of the infrared furnace is not less than 1°C/sec, and more preferably 50°C/sec. ~~Regarding~~The processing parameters ~~of~~for using infrared rays ~~for joining~~to join golf club head members, including the preheating temperature, heating rate, vacuum condition, processing temperature and time, are described more detail in FIG. 3.

~~Using~~The method of using infrared rays for quick joining the golf club head is ~~processed in~~involves the use of an atmosphere. In other words, in order to avoid oxidation of the metallic filler member 10 during the process, the golf club head is processed in a vacuum or inert gas including nitrogen, ~~argon and helium etc.~~argon, and/or helium, for example.

FIGS. 4a through 4d ~~illustrate~~are SEM(Scanning Electron Microscope) photographs demonstrating the method of using~~utilizing~~ infrared rays for a joint of Ti-6Al-4V, Ag and 17-4PH at 1,000 degrees centigrade for 30 sec. The alloying effect upon

~~interfaces of the joint of Ti-6Al-4V, Ag and 17-4PH is obviously composed of Ti-6Al-4V, Ag and 17-4PH at 1,000°C for 30 seconds. As can be seen in these photographs, the alloying effect on the inner faces of the joint composed of Ti-6Al-4V, Ag and 17-4PH has been suppressed.~~

FIG. 5 ~~is illustrates~~ an experimental data diagram of a shearing test for a joint ~~consisted~~ consisting of Ti-6Al-4V, Ag and 17-4PH. ~~It appears that an excellently joined quality is carried out~~ As can be seen in this data, high joint quality is achieved if the processing temperature is low or the processing time is short. The alloying effect between Ti-6Al-4V and Ag, or between Ag and 17-4PH steel, is greatly decreased since ~~it is using~~ by the use of infrared rays for quick joining. ~~The averaged joining the golf club members.~~ The average shear strength of pure silver filler is as high as 91.7 MPa. In addition, a compact joint is accomplished by ~~using~~ the use of infrared heating.

FIG. 6a ~~illustrates~~ are SEM photographs demonstrating the use of using infrared rays for ~~joining to join~~ materials consisted consisting of Ti-6Al-4V, 72Ag-28Cu and 17-4PH at ~~800 degrees centigrade for 120 sec.~~ 800°C for 120 seconds. FIG. 6b ~~illustrates an EPMA (Electron Probe Microanalyzer)~~ is an EPMA data diagram of analyzing the chemical composition of ~~the joint consisted of Ti-6Al-4V, 72Ag-28Cu and 17-4PH at 800°C for 120 seconds.~~ a joint consisting of Ti-6Al-4V, 72Ag-28Cu and 17-4PH at 800°C for 120 seconds. ~~28Cu and 17-4PH at 800 degrees centigrade for 120 sec.~~ In FIG. 6a, the Ti-Cu compounds (TiCu, Ti<sub>2</sub>Cu<sub>3</sub>, TiCu<sub>4</sub>) are observed at the interface between Ti-6Al-4V and ~~the~~ 72Ag-28Cu. It can also be ~~found~~ shown that Cu atoms of the metallic filler (72Ag-28Cu) react with Ti-6Al-4V, but Ag atoms do not react with Ti-6Al-4V. Thus, there is a decrease ~~of~~ in Cu content from the 72Ag-28Cu filler.

FIGS. 7a through 7c ~~illustrate~~ are SEM photographs demonstrating the use of using infrared rays for ~~joining to join~~ materials consisted consisting of Ti-6Al-4V, 72Ag-28Cu and 17-4PH at ~~850 degrees centigrade~~ 850°C for various processing ~~time~~ times. Referring to FIGS. 6 and 7, as the processing temperature is increased or the heating time is prolonged, the thickness of a reaction layer defined between the metallic filler (72Ag-28Cu) and the base metal (Ti-6Al-4V) becomes thicker. ~~During 30 sec of the heating time,~~ When heating time is limited to 30 seconds, the molten metallic filler ~~cannot~~ does not have time to completely react with the base metal ~~since the heating time is short.~~ The Cu atoms of the metallic filler (72Ag-28Cu) react with Ti-6Al-4V, but Ag atoms do not react

with Ti-6Al-4V. Thus, there is a decrease of Cu content from the 72Ag-28Cu filler. As the heating time is increased, the original eutectic microstructure is changed into a hypoeutectic microstructure, due to depletion of Cu content from the molten 72Ag-28Cu filler. Consequently, there exists a large scale of Ag-enriched phase in the joint, as is illustrated in FIGS. 7b and 7c.

FIG. 8 illustrates an experimental data diagram of a shear test for a joint consisting of Ti-6Al-4V, 72Ag-28Cu and 17-4PH in various processing conditions. The average maximum shear strength is about 96.4 MPa at 800 degrees centigrade of processing temperature for 120 seconds of heating time. It can be found that the shear strength of the joint may have a trend of a decrease, tends to decrease as the processing temperature is increased or the heating time is prolonged. This can be attributed to the growth of continuous reaction layer(s) in the interface, which thereby cause a decrease in the shear strength of the joint. The result of the metallic fillers in this embodiment is similar to that of the pure silver. The improved shear strength of the joint may be obtained even if the processing temperature is low or the heating time is short. In other words, using infrared rays for quick joining golf club head members can suppress the interfacial reactions between the filler of 72Ag-28Cu and the base metal of Ti-6Al-4V, or between the filler of 72Ag-28Cu and the base metal of 17-4PH.

FIGS. 9a through 9d illustrate SEM photographs demonstrating the use of using infrared rays for joining materials consisting of Ti-6Al-4V, 95Ag-5Al and 17-4PH at various degrees centigrade for a predetermined processing time. In FIGS. 9a through 9d, no continuous reaction layer has been identified in the joint between the metallic filler and the base metals. EPMA analysis for chemical composition cannot be processed accurately, because the thickness of the reaction layer is less than 1  $\mu$ m.

[0042] FIG. 10 illustrates an experimental data diagram of a shear test for a joint consisting of Ti-6Al-4V, 95Ag-5Al and 17-4PH in various processing conditions. The result of the metallic filler (95Ag-5Al) in this embodiment is similar to that of the pure silver. Using infrared rays for quick joining golf club head members can suppress both the interfacial reaction as well as the alloying effect between the filler and

the base metals. ~~The better~~ Thus, improved strength of the joint may be obtained even if the processing temperature and/or time is decreased.

Using infrared rays for quick joining the golf club head ~~is applied to suppress the~~ suppresses growth of interfacial intermetallic compound(s), thereby reducing ~~—with~~ brittleness, ~~to increase~~ increasing quality of products product quality and, manufacturing efficiency, and decreasing the utility rate of power consumption. Therefore, infrared rays can be widely applied in joining the golf club head members. It is anticipated that ~~The method of the present invention greatly increases the product quality of the golf club head product is greatly increased and significantly decreases the manufacture cost manufacturing costs~~ is significantly decreased.

~~Although the invention has been described in detail with reference to its presently preferred embodiment, it will be understood by one of ordinary skill in the art that various modifications can be made without departing from the spirit and the scope of the invention, as set forth in the appended claims. The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.~~